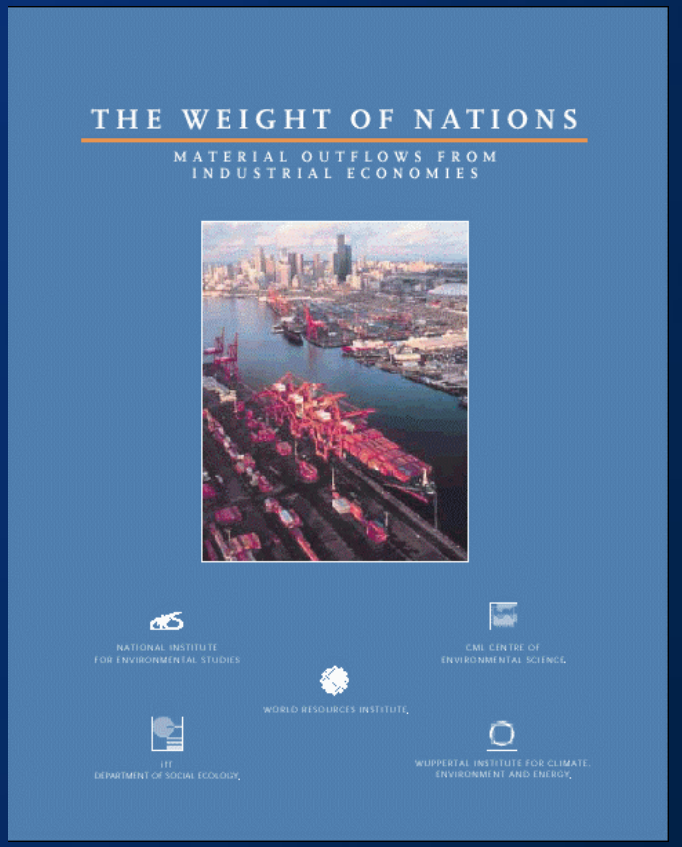
The Weight of Nations



World Resources Institute, U.S.A.

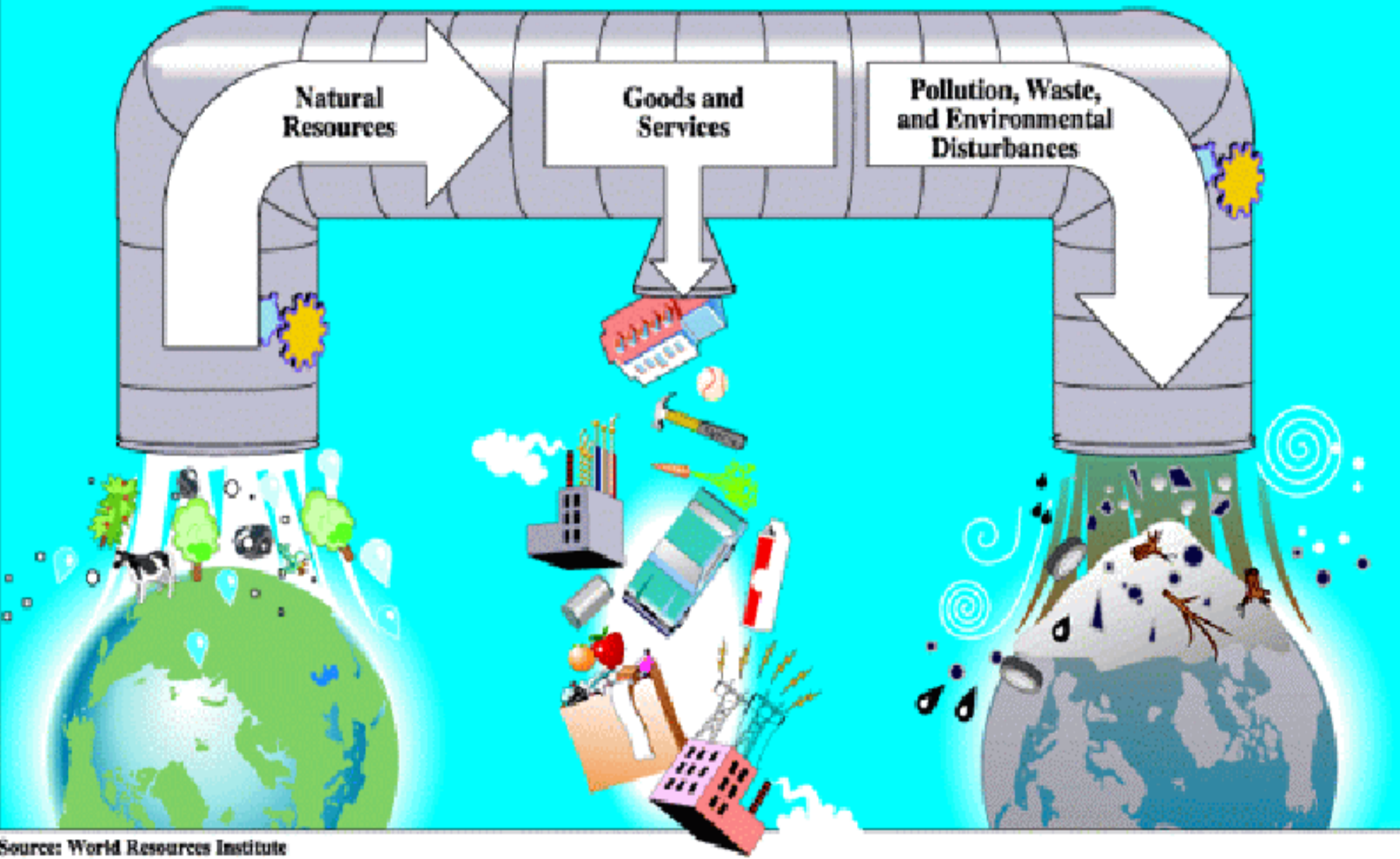
Wuppertal Institute, Germany

University of Vienna, Department of Social Ecology, Austria

University of Leiden, Centre of Environmental Science, the Netherlands

National Institute for Environmental Studies, Japan

The Materials Cycle



Source: World Resources Institute

Non-Renewable Material Flows Tracked for this Study

Industrial Minerals	Metals	Fossil Fuels
Asbestos	Aluminum	Liquid
Bromine	Arsenic	Natural gas
Clay	Cadmium	Solid
Fluorspar (fluorine)	Chromium	Coal combustion products
Gypsum	Copper	
Nitrogen (ammonia)	Gold	
Phosphate	Iron metal (steel)	
Potqash	Iron and steel slag	
Salt	Lead	
Chlorine	Manganese	
Caustic soda	Mercury	
Sand and Gravel, Industrial	Molybdenum	
Soda ash	Nickel	
Sulfur	Tin	
	Zinc	

Non-Renewable Material Flows Tracked for this Study

Construction Materials	Movements of Earth	Nonrenewable Organic Material
Crushed stone	From soil erosion	Petroleum
Cement	For highway construction	Asphalt
Lime	For general construction	Petrochemicals
Sand and gravel	From dredging operations	Plastics and resins
		Medical chemicals
		Synthetic rubber
		Petroleum coke

Renewable Material Flows Tracked for this Study

Agriculture	Forestry
Animal biomass and manures	Natural rubber
Crops biomass	Wood products
Human wastes and manures	Paper and pulp products

The Materials Flow Cycle

Imports

Exports

Domestic Extraction

Domestic Wastes *(to air, land, and water)*

The Materials Flow Cycle

Foreign Hidden Flows

Imports

Exports

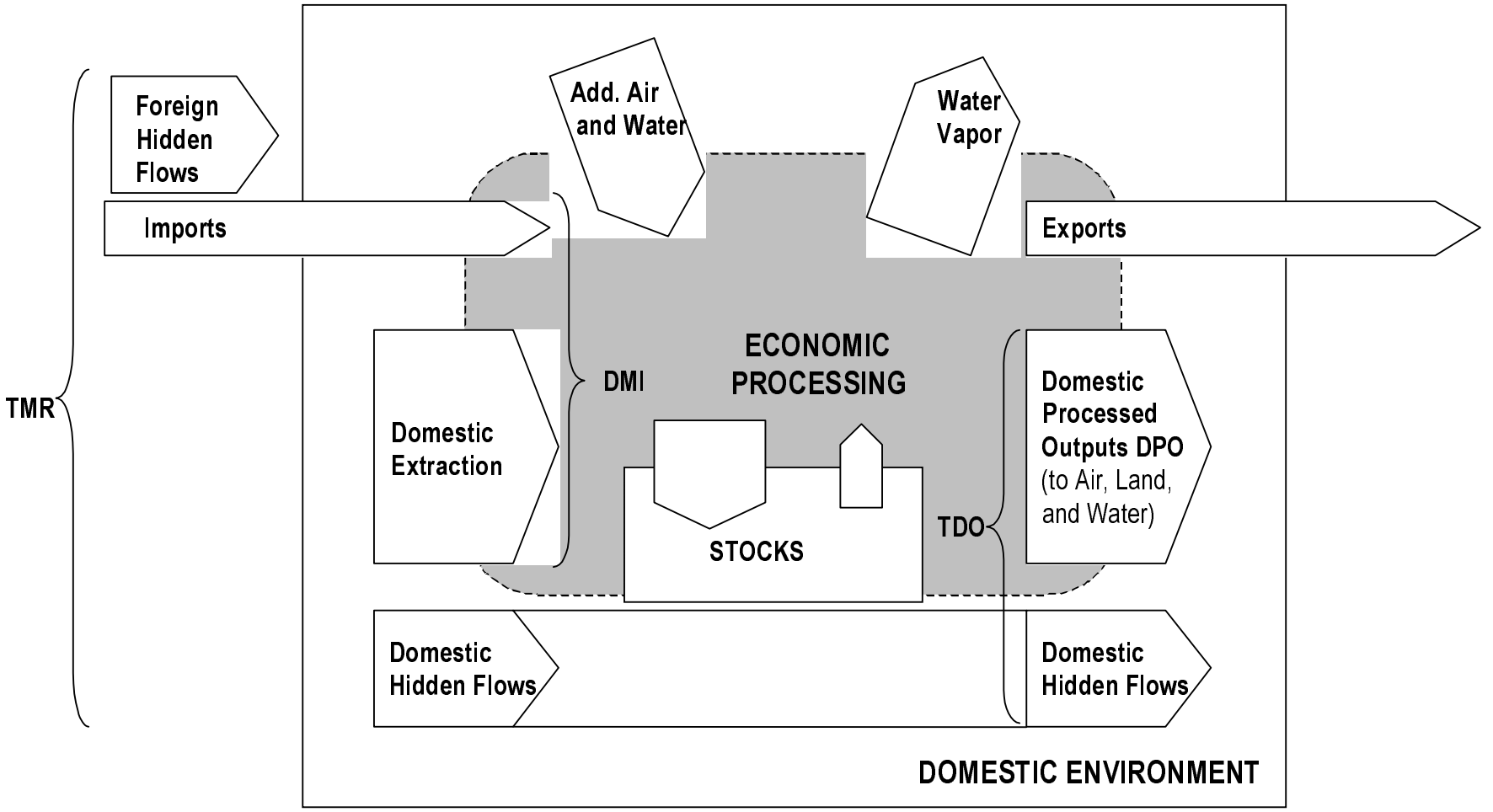
Domestic Extraction

Domestic Wastes *(to air, land, and water)*

Domestic Hidden Flows

Domestic Hidden Flows

The Materials Flow Cycle

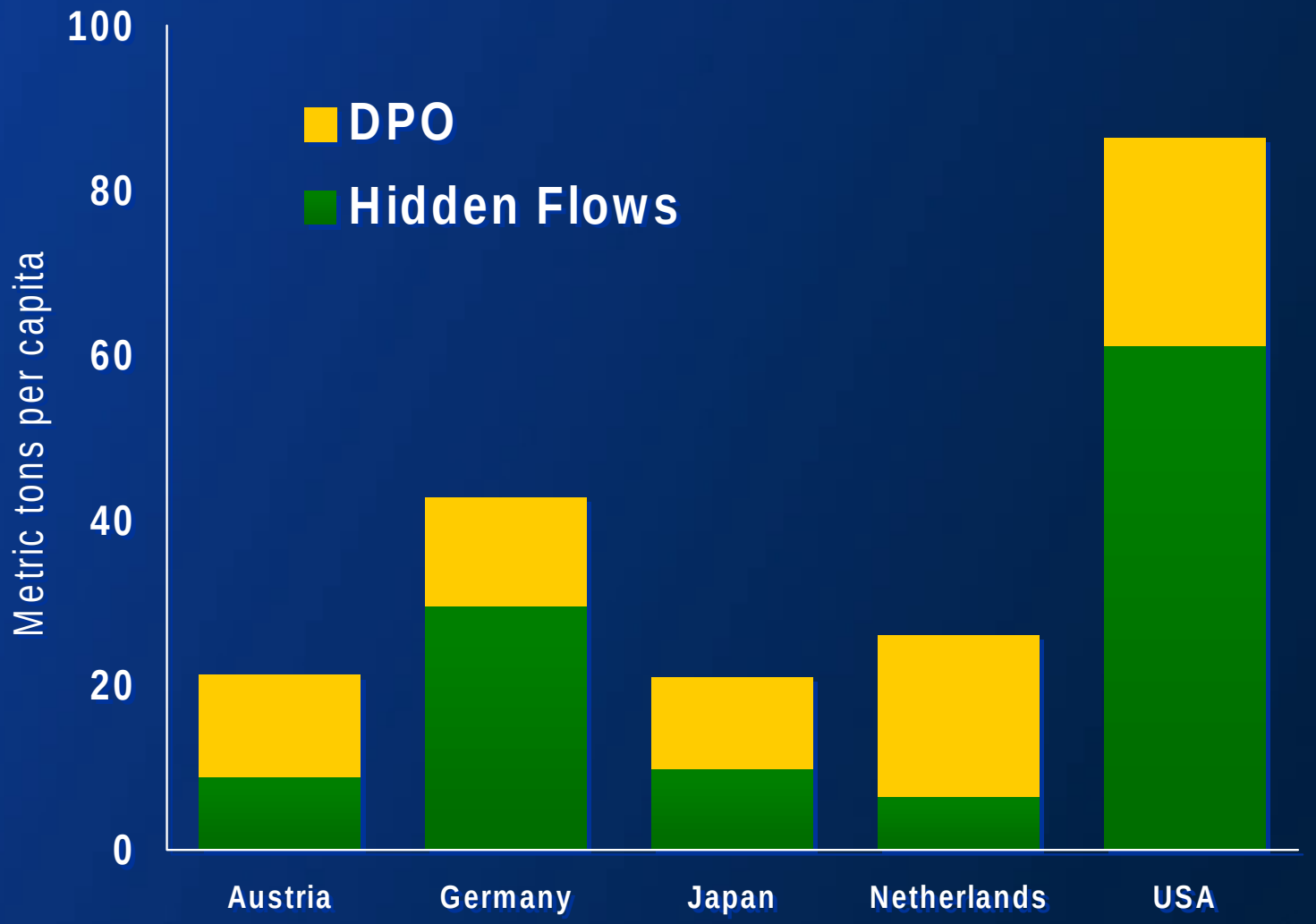


DMI (Direct Material Input) = Domestic Extraction + Imports
TMR (Total Material Requirement) = DMI + Domestic Hidden Flows + Foreign Hidden Flows
DPO (Domestic Processed Output) = DMI – Net Additions to Stock – Exports
TDO (Total Domestic Output) = DPO + Domestic Hidden Flows
NAS (Net Adddition to Stock) = DMI - DPO - Exports

Analyzing Material Flows

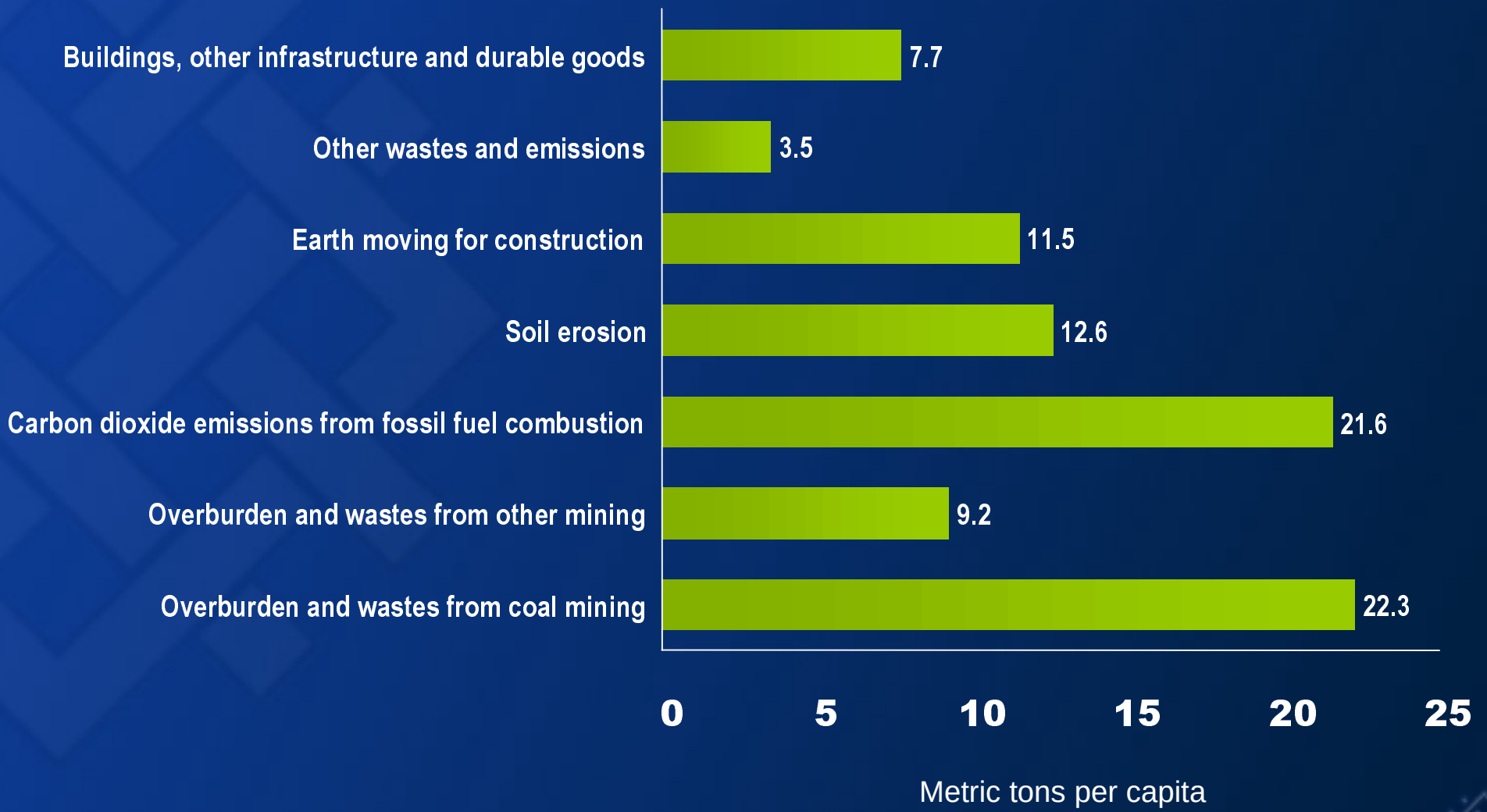
- Absolute size of flows (conventional and hidden)
- Composition of flows (dominance of energy system, hazardous materials)
- Use vs. waste
- Links to economy and population

Total Domestic Output, 1996

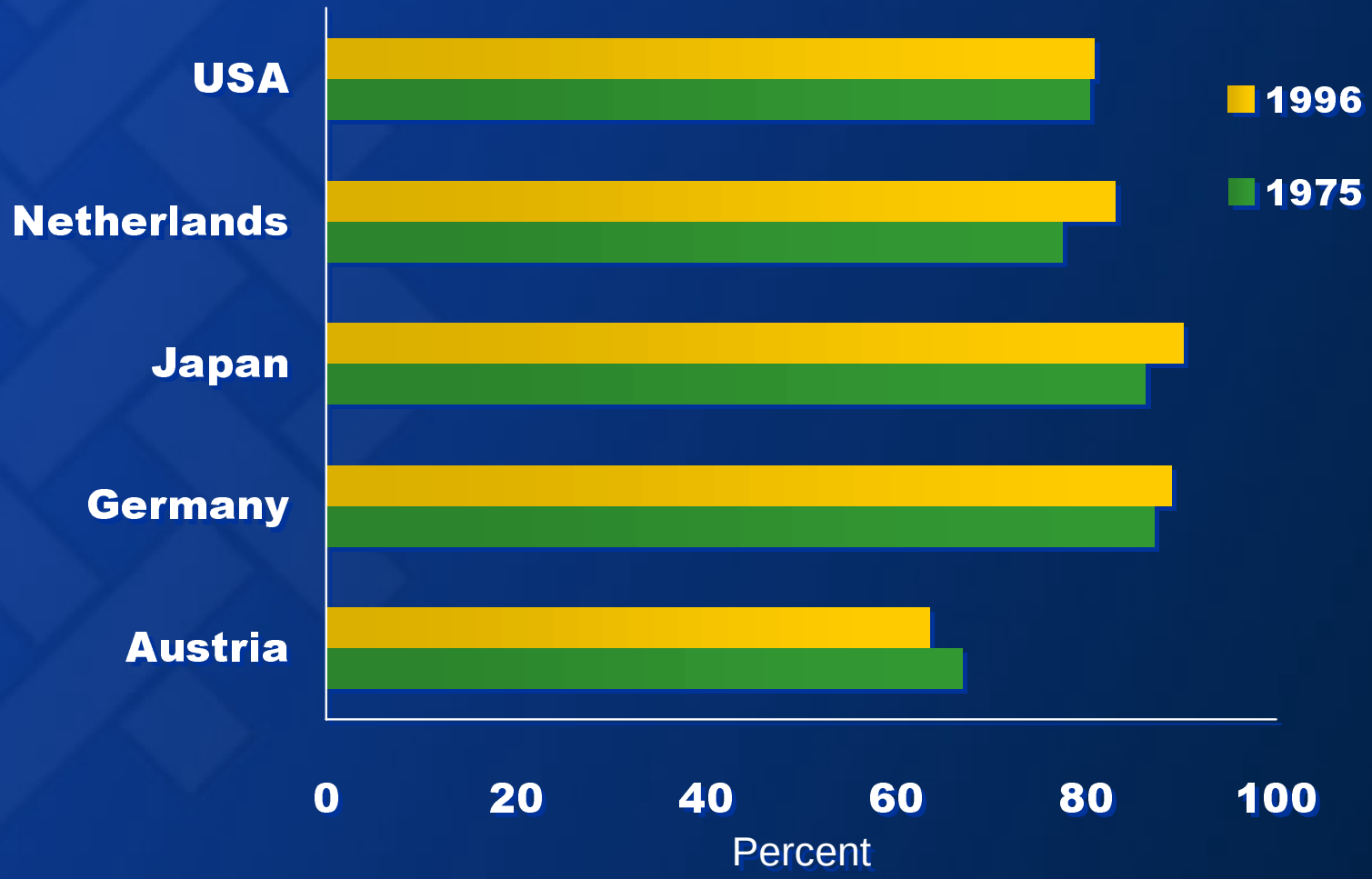


Composition of U.S. Total Domestic Output, 1996

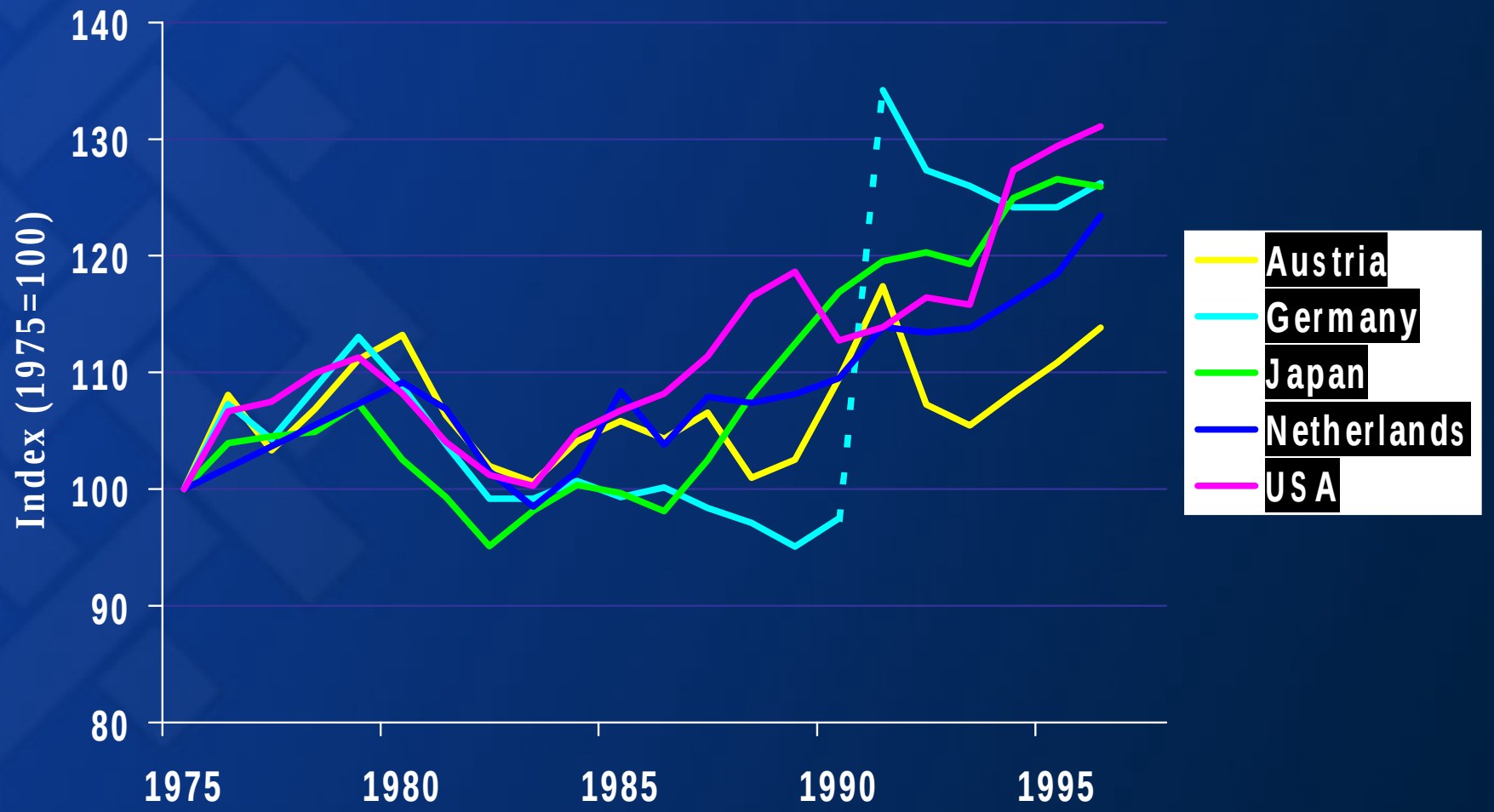
Material Flows Per Person in the U.S., 1996



Carbon Dioxide as a Percentage of DPO, 1996



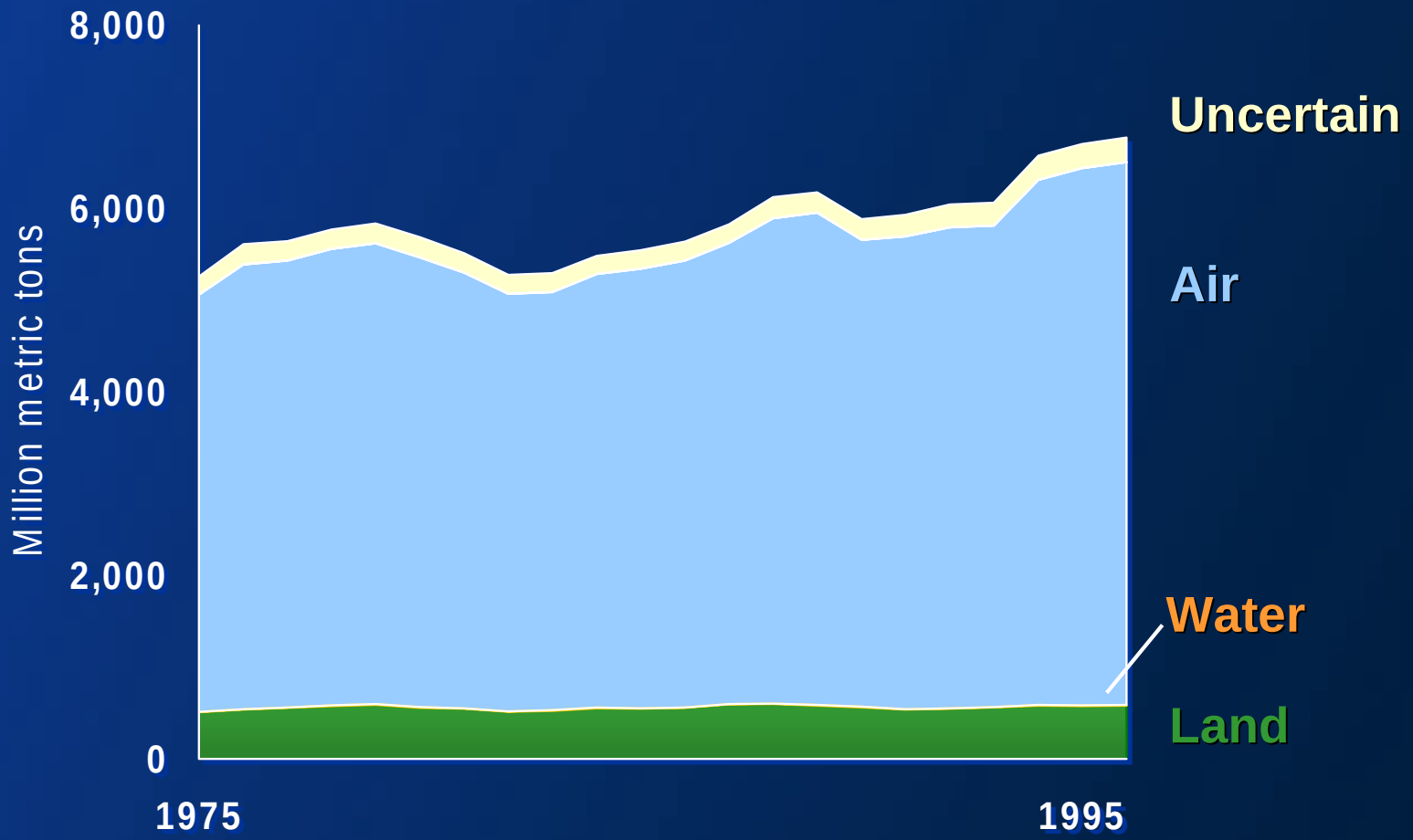
CO_2 Output from Fossil Fuel Combustion and Industrial Processes, 1975-1996 (Index)



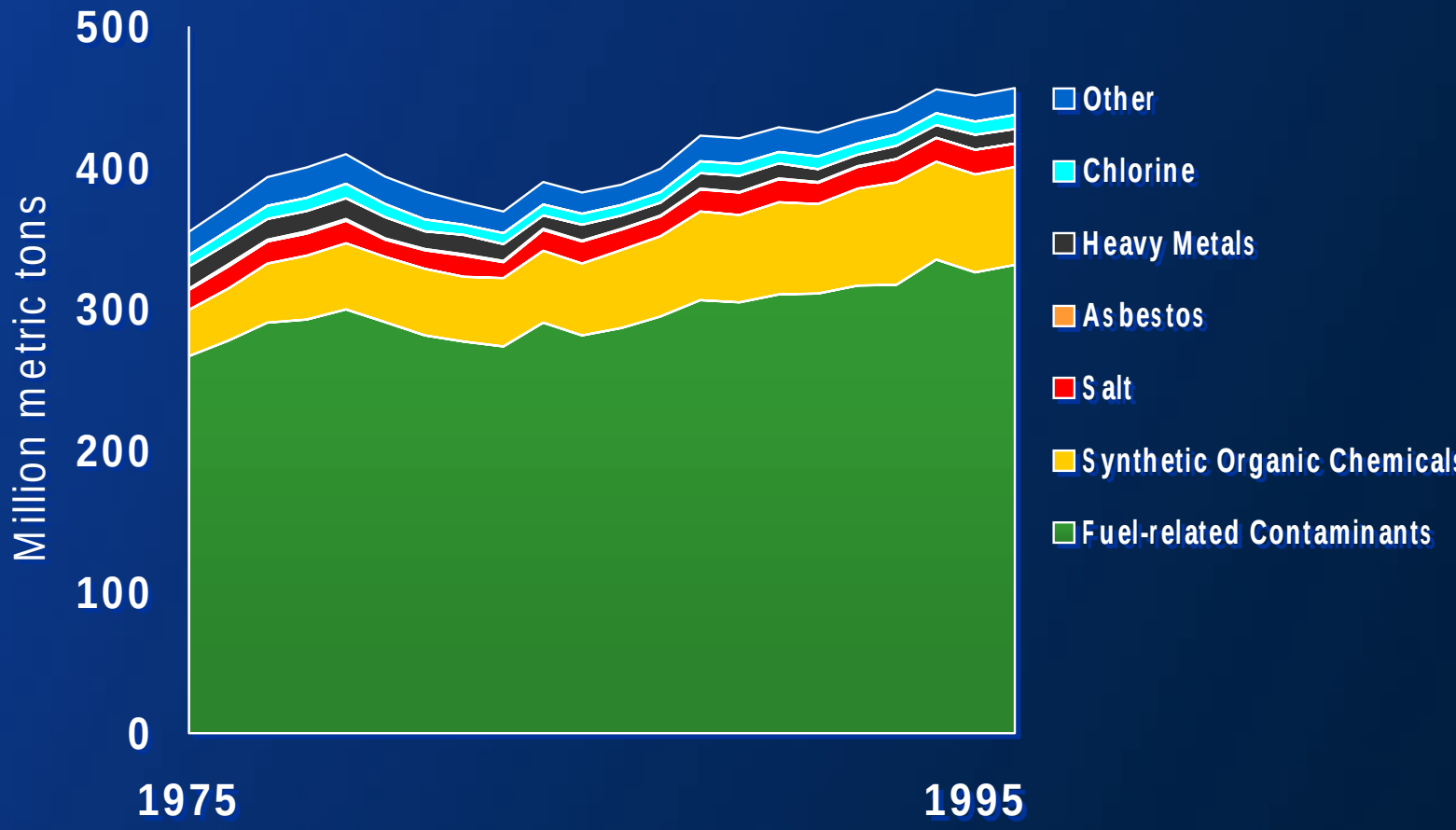
A Pilot Characterization Scheme

- Mode of release (M)
- Physical-chemical qualities (Q)
- Velocity (V)

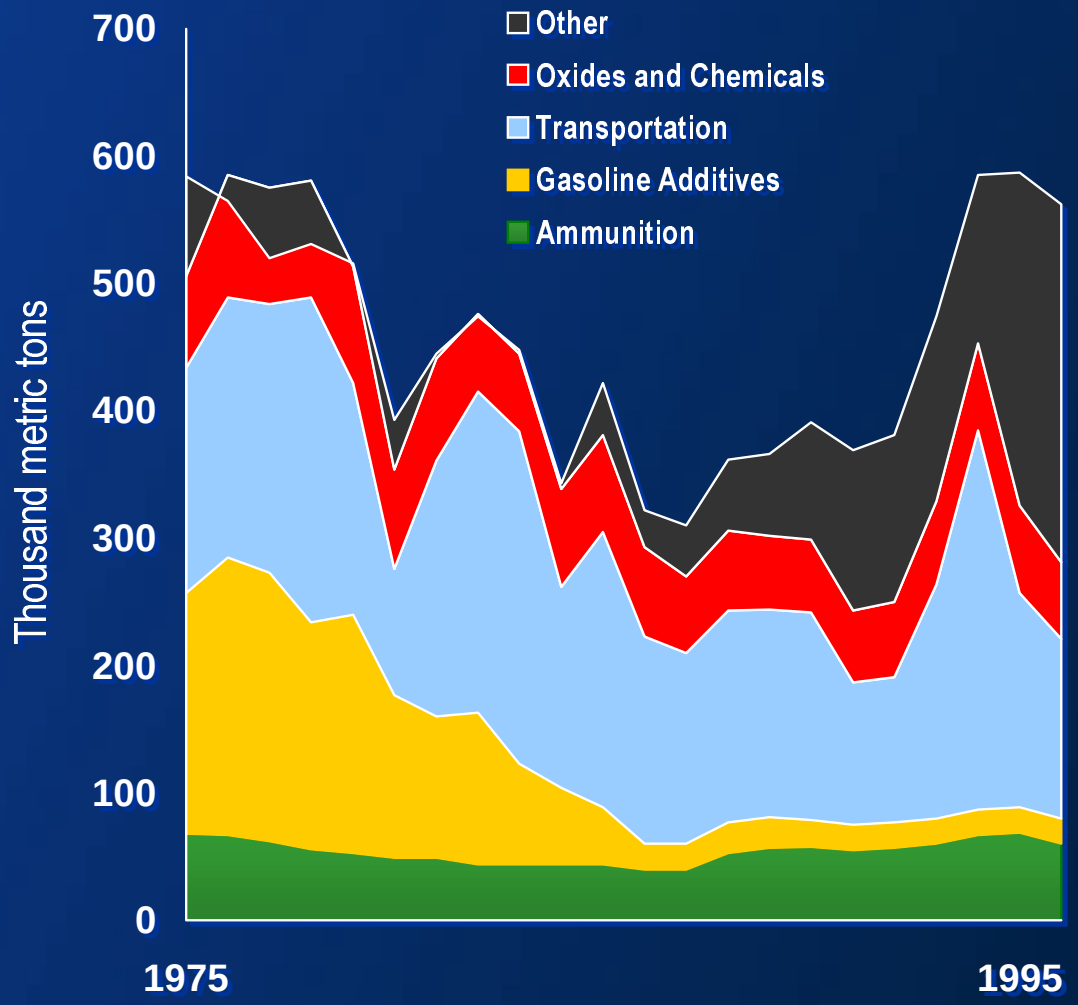
Outputs to Air, Land, and Water in the U.S., 1975–96



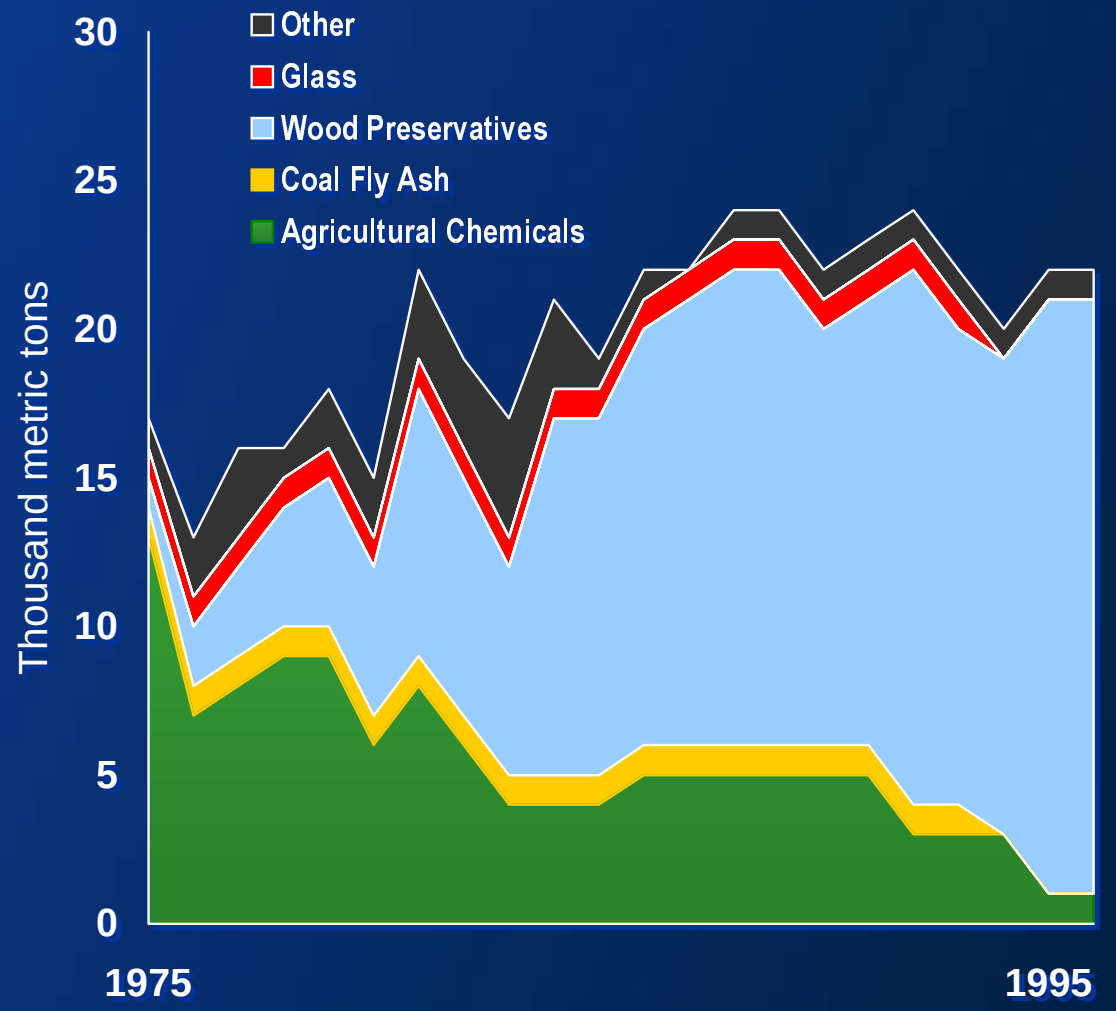
Potentially Hazardous Outflows to the U.S. Environment, 1975–96



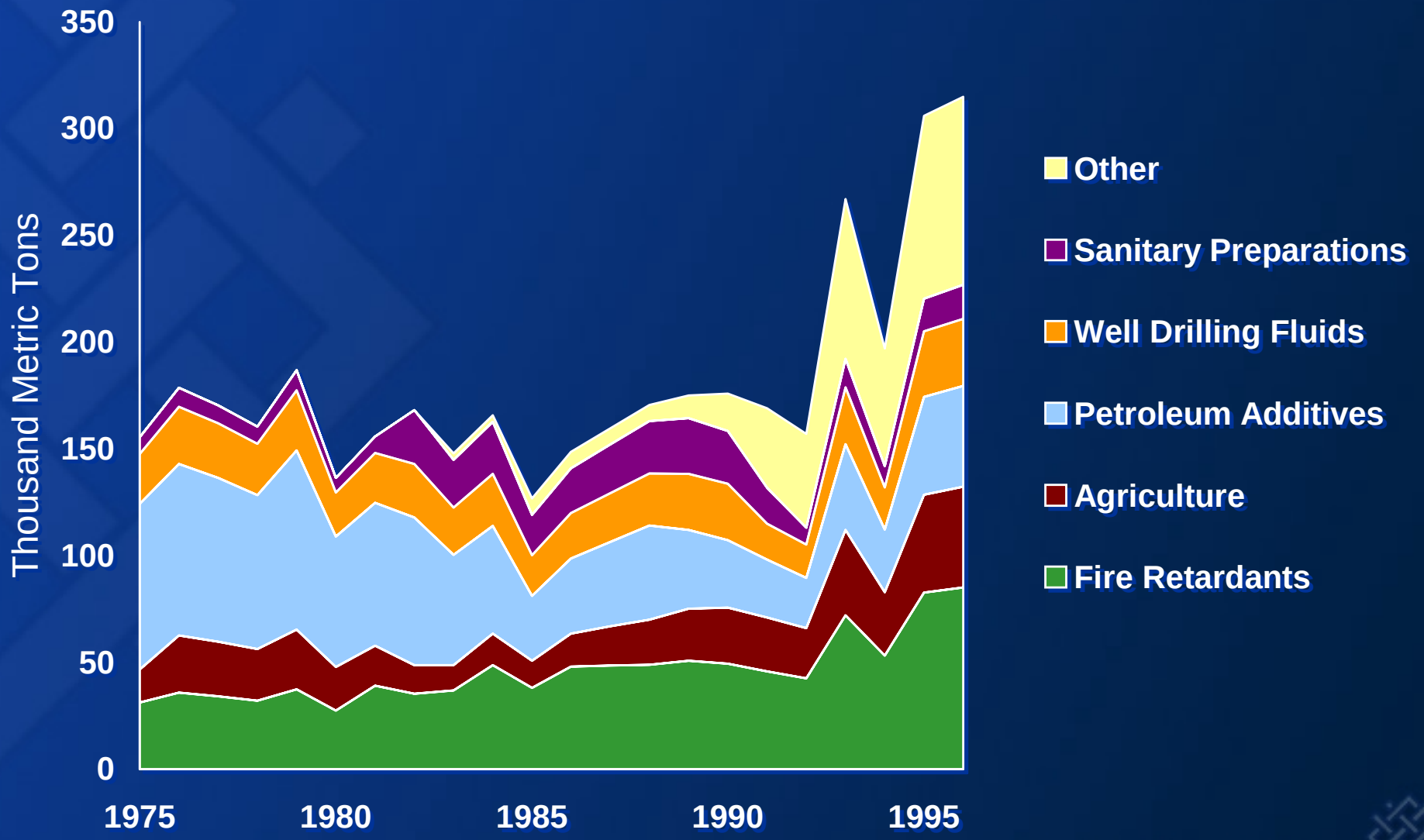
Lead Outputs to the U.S. Environment, 1975–96



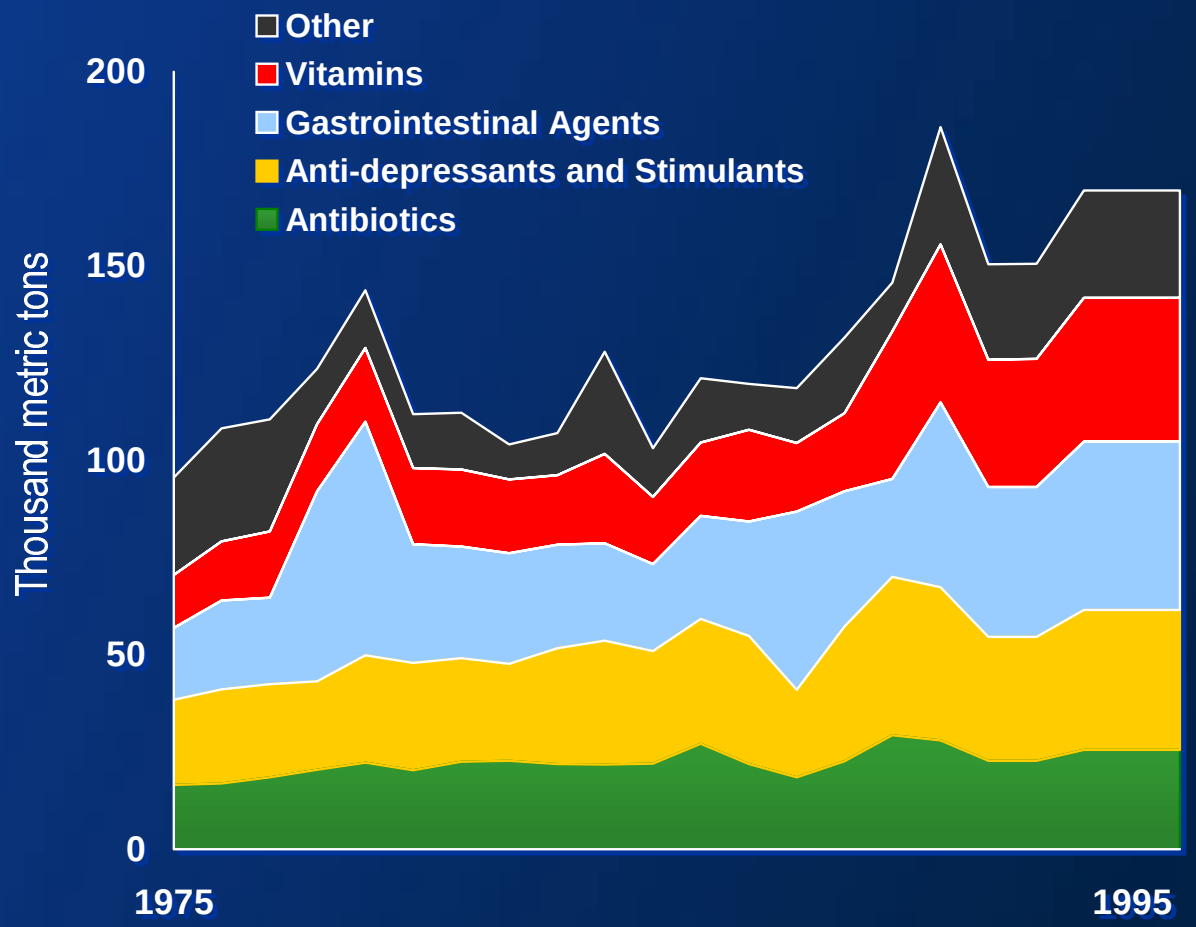
Arsenic Use in the U.S., 1975–96



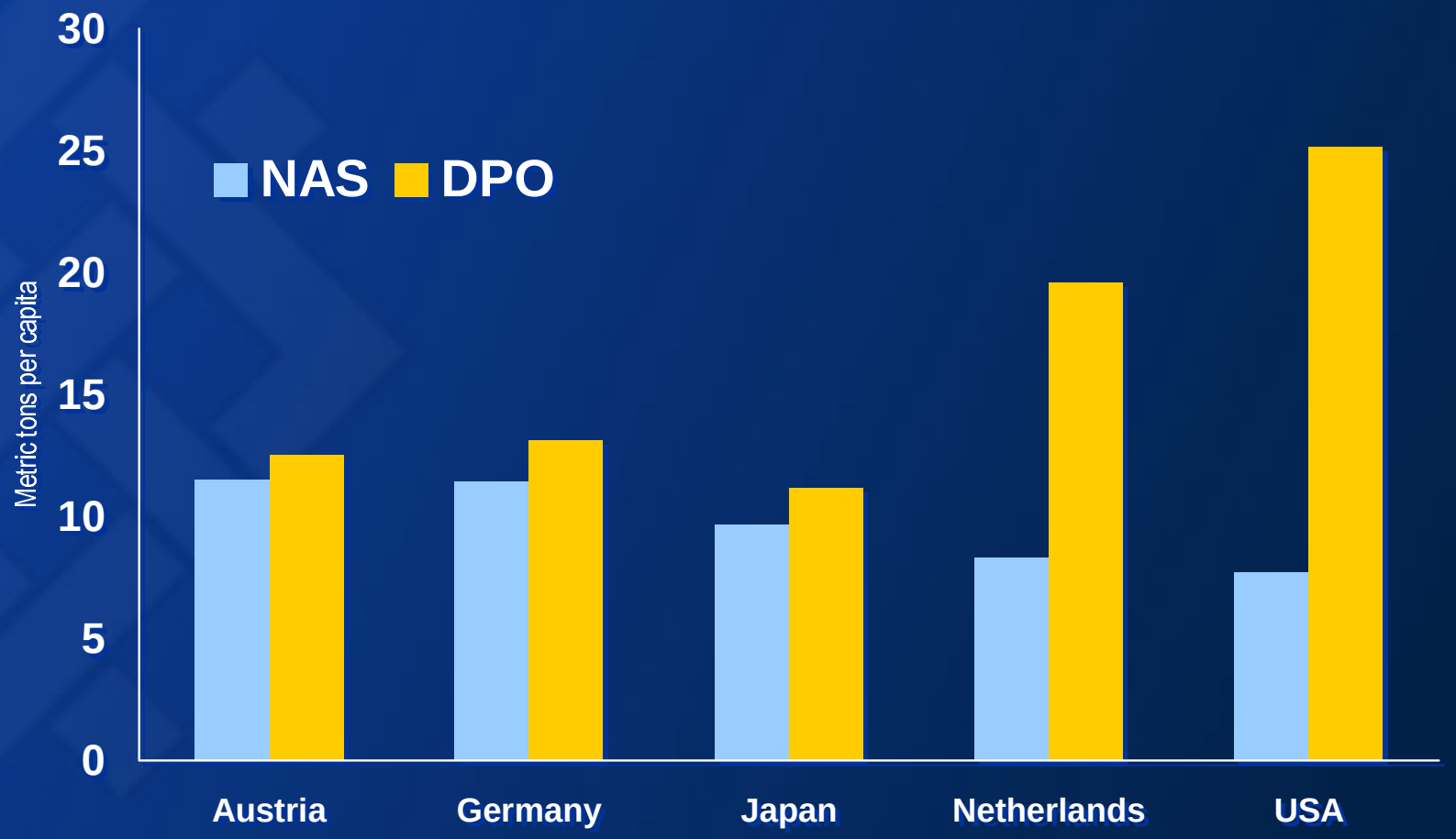
Bromine Outputs in the U.S., 1975–1996

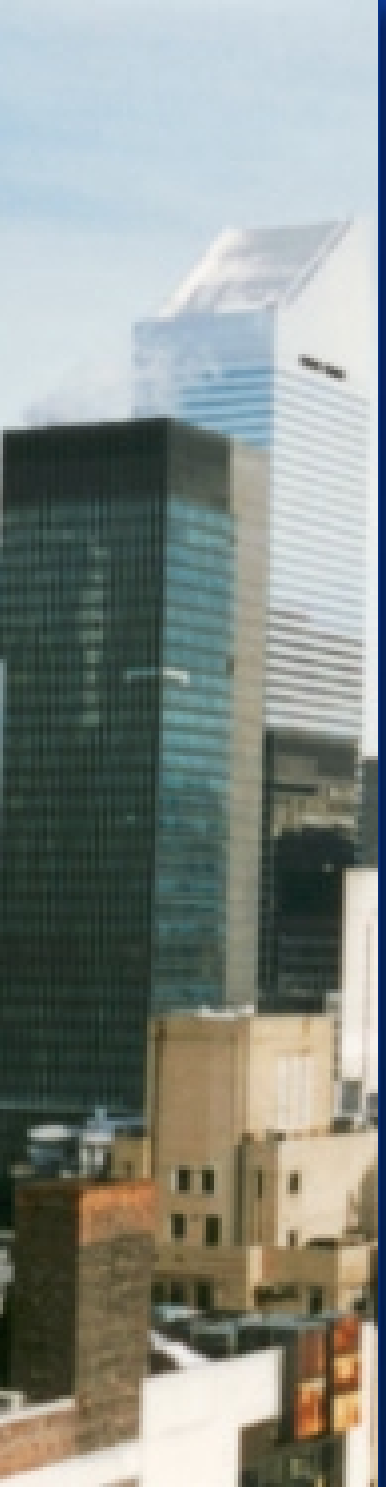


Medical Chemical Outputs to the U.S. Environment, 1975–96

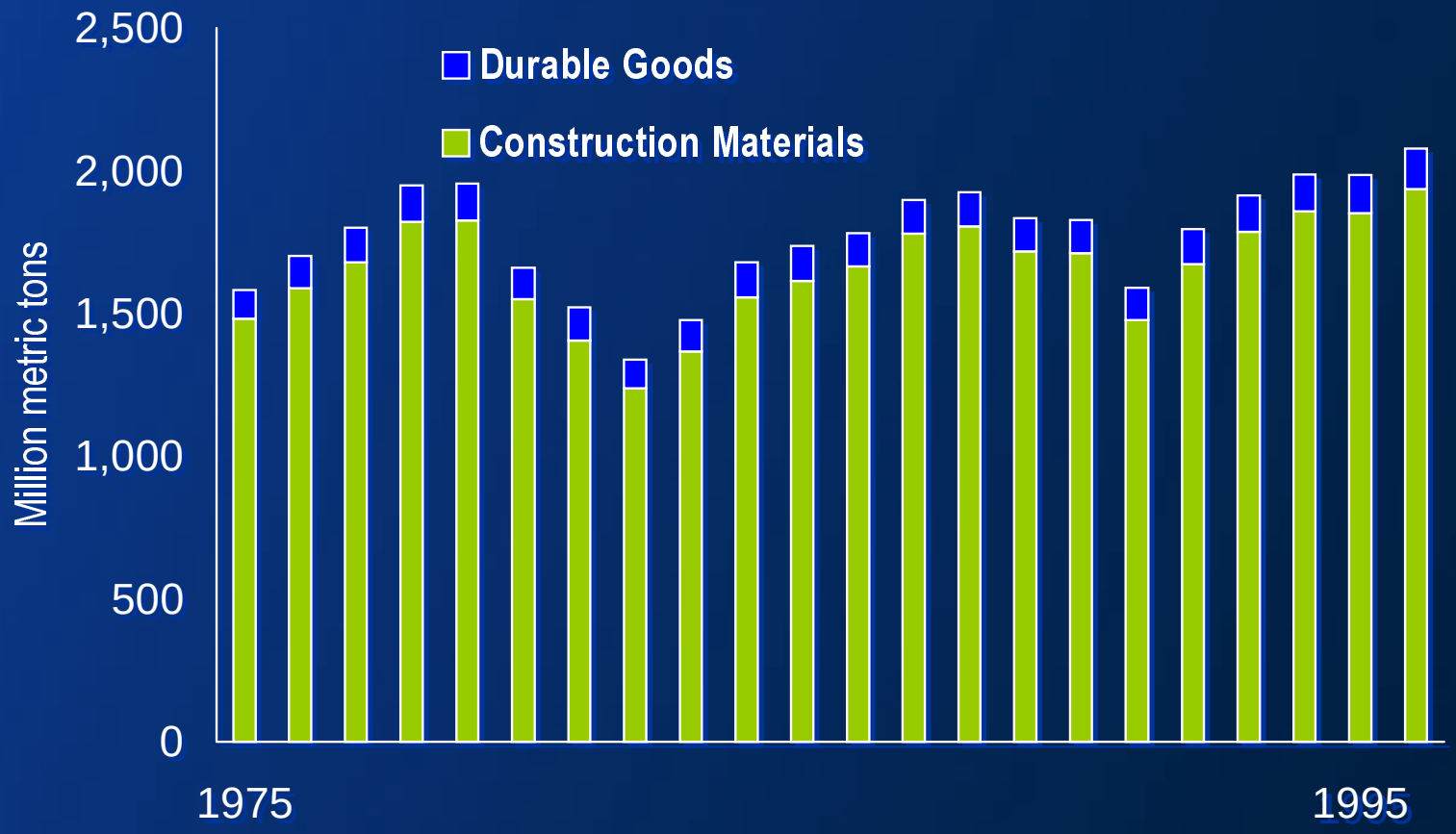


Net Additions to Stock, and Domestic Processed Output, 1996

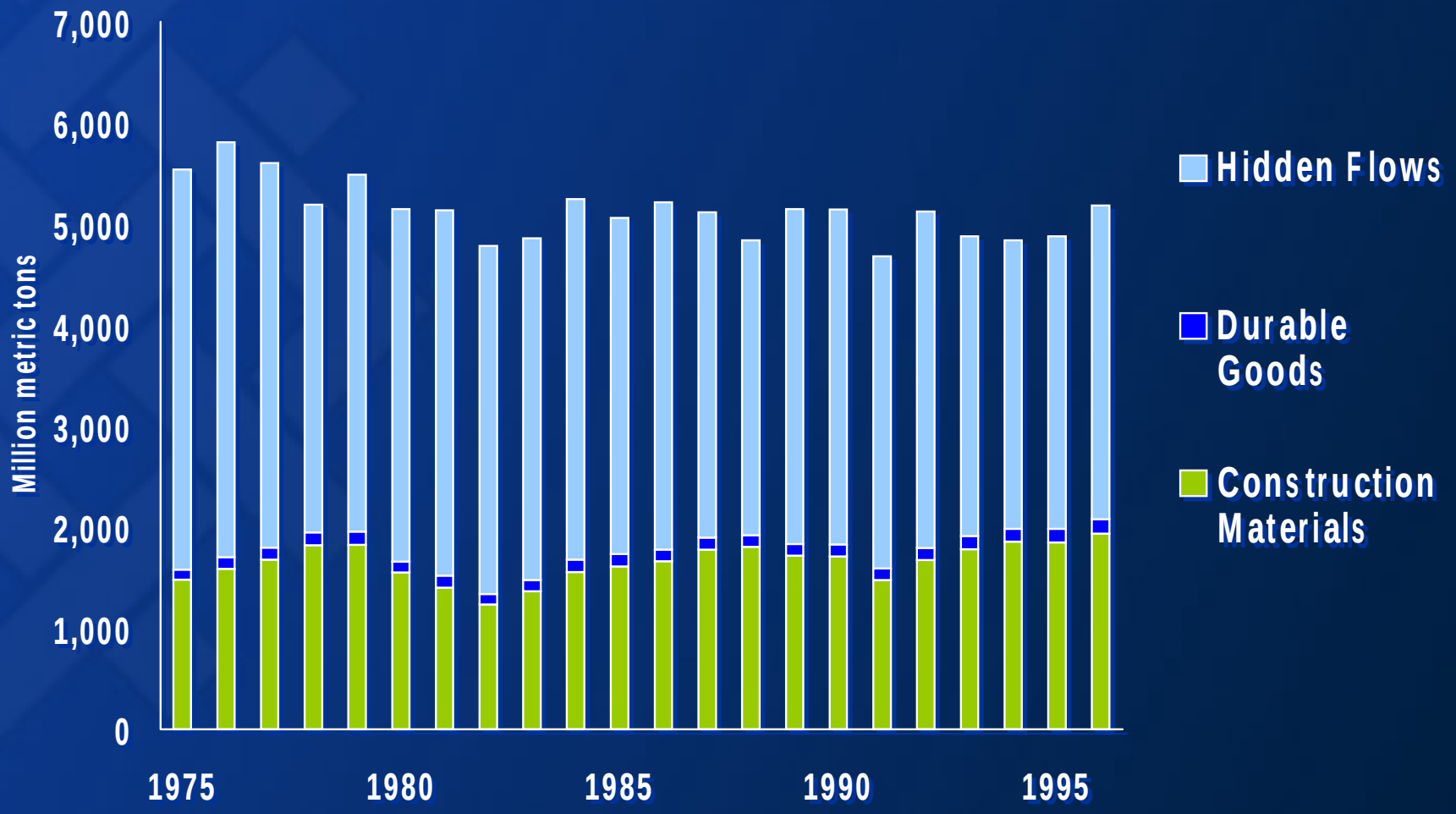




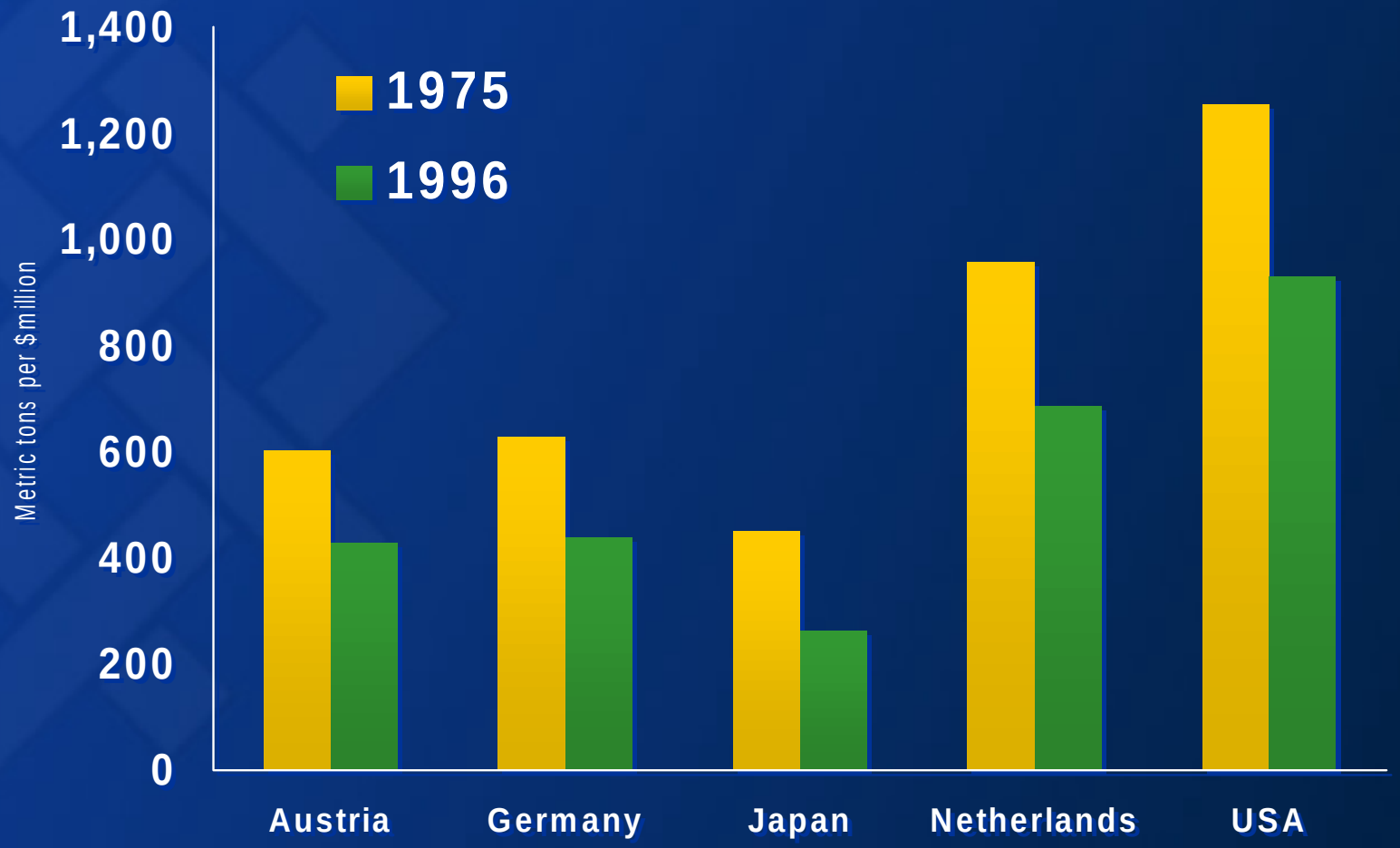
Net Additions of Material to Stock in the U.S., 1975–96



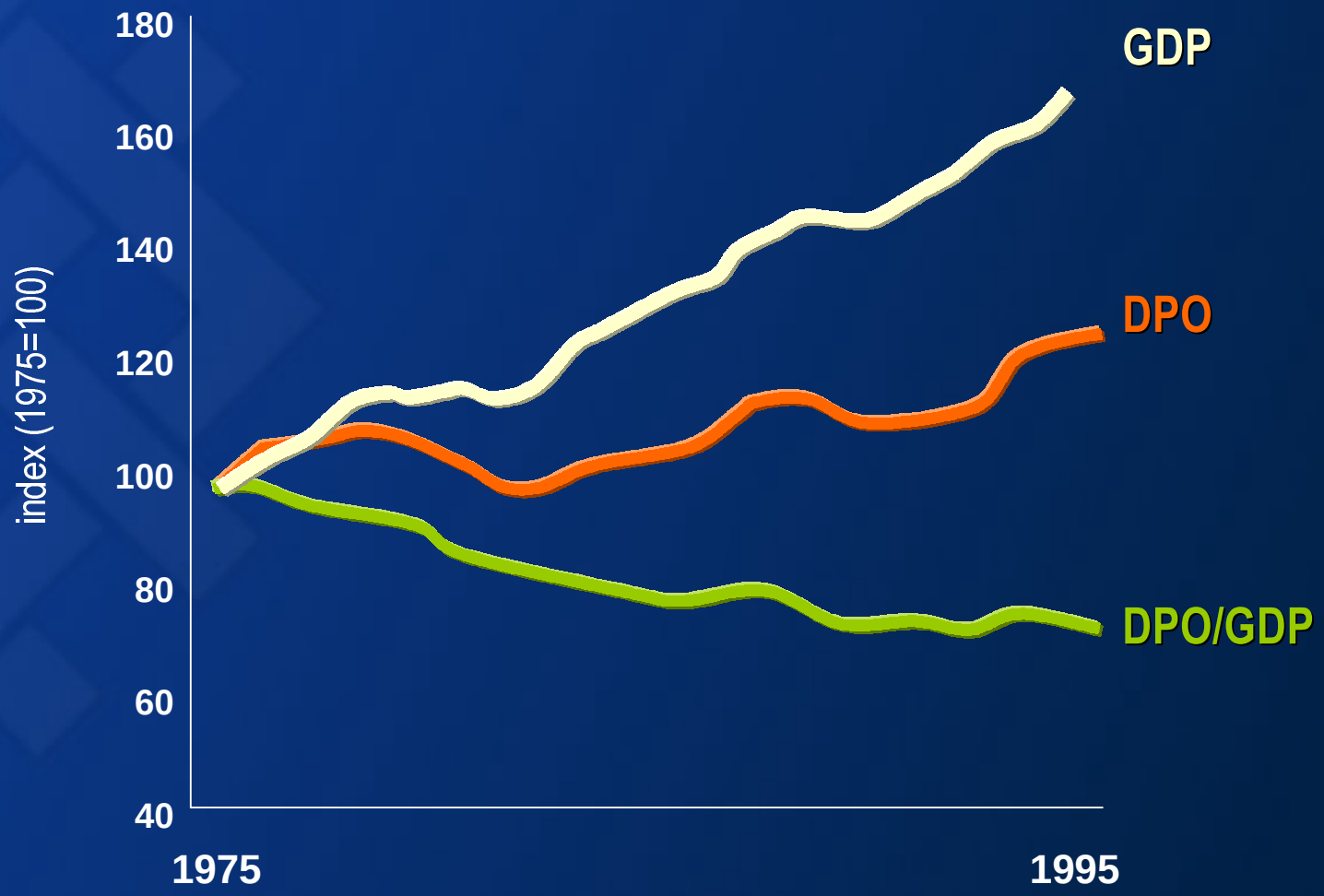
Stock Materials and Associated Hidden Flows in the U.S., 1975–1996



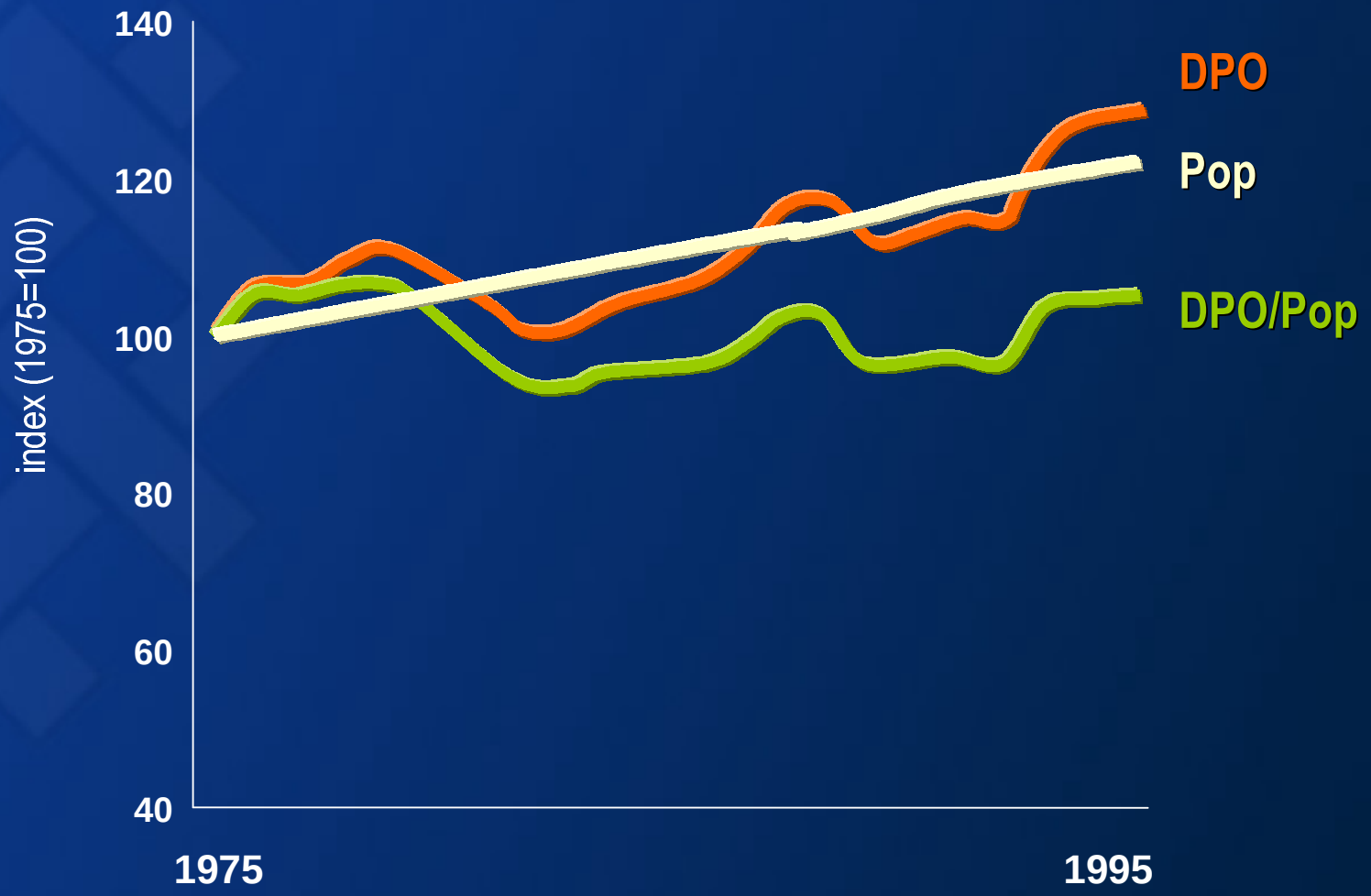
Domestic Processed Output Per Constant Unit of GDP (U.S. Dollars), 1975 and 1996



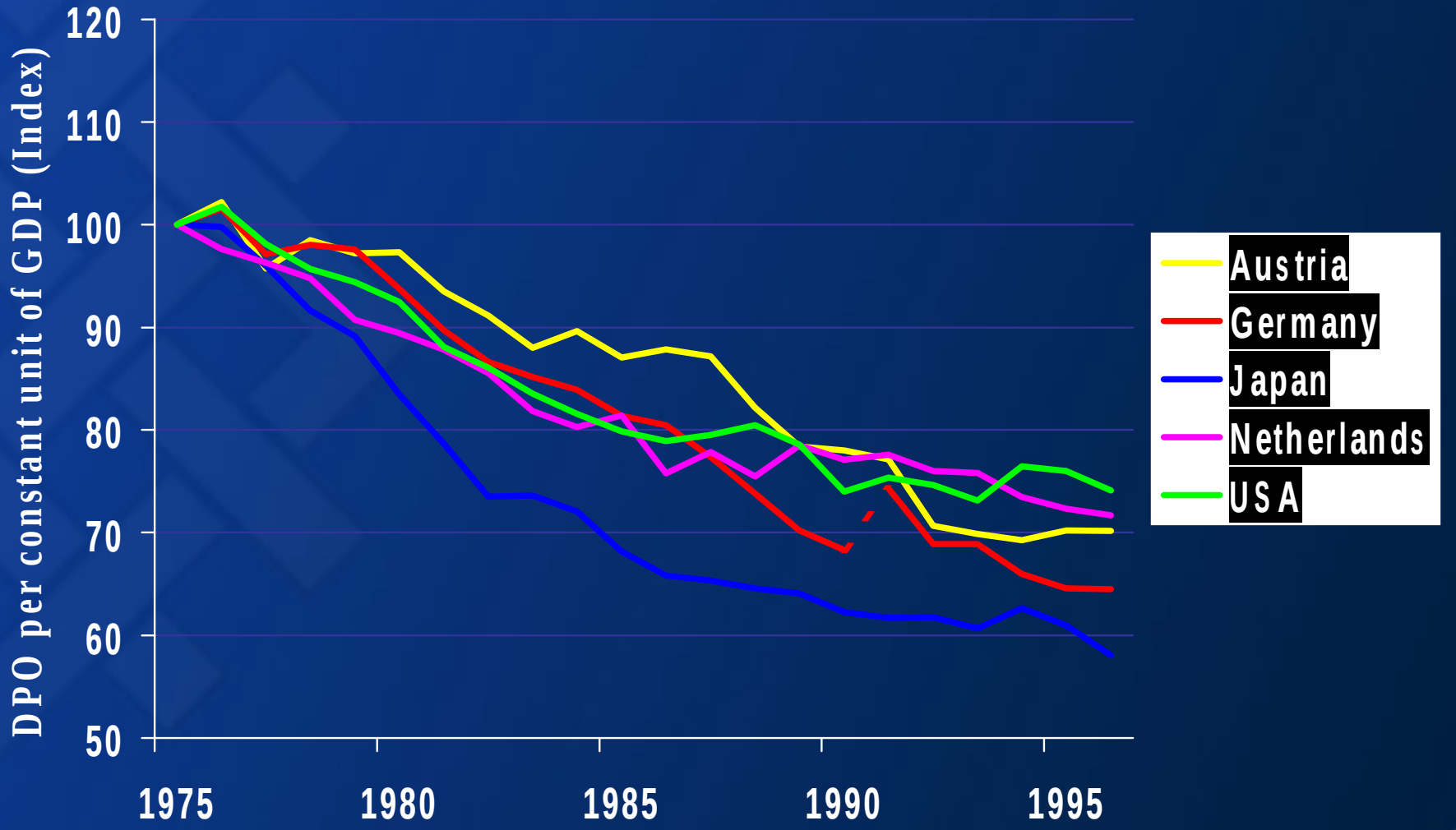
Decoupling between Material Outputs and GDP in the U.S., 1975–96



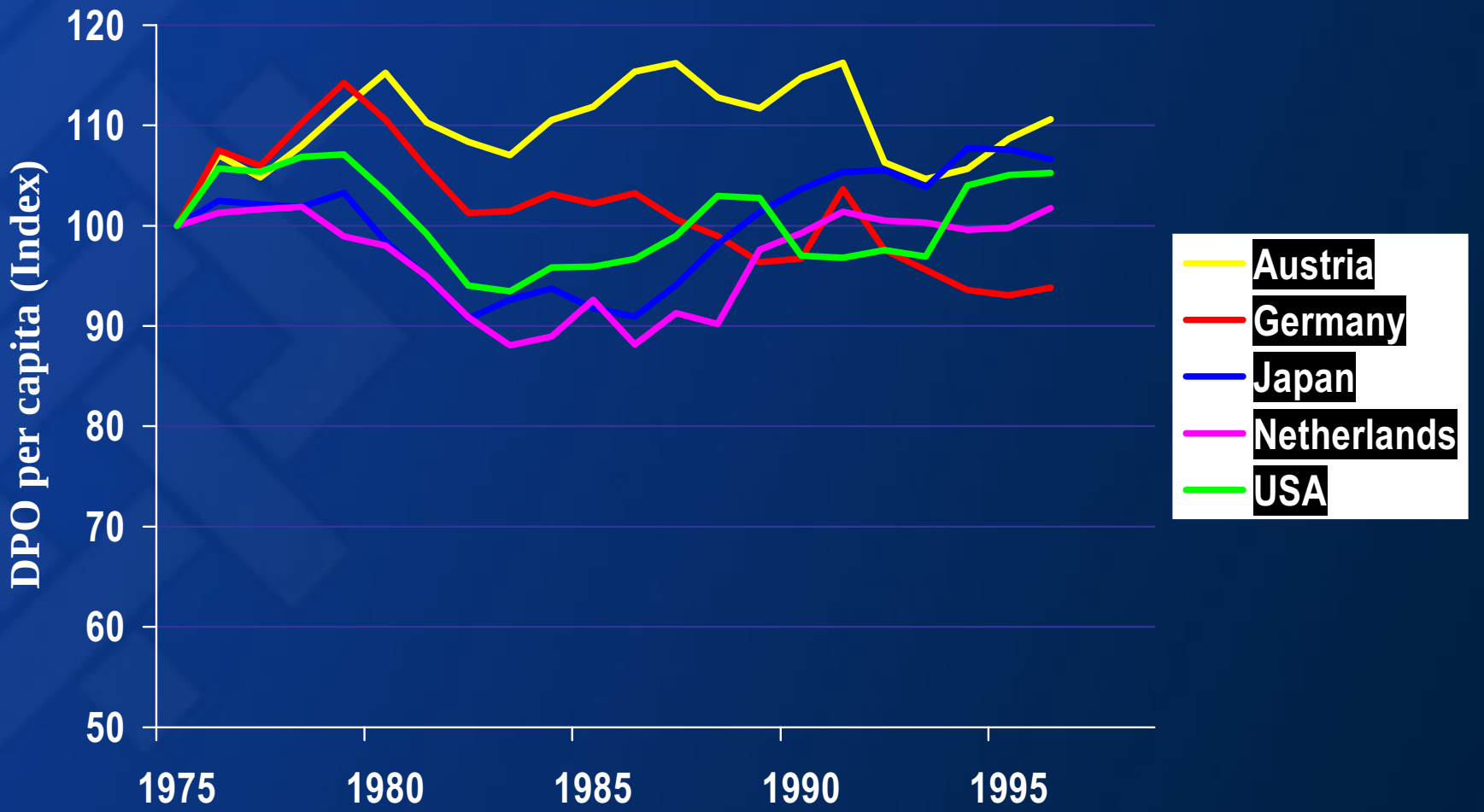
Decoupling between Material Outputs and Population in the U.S., 1975–96



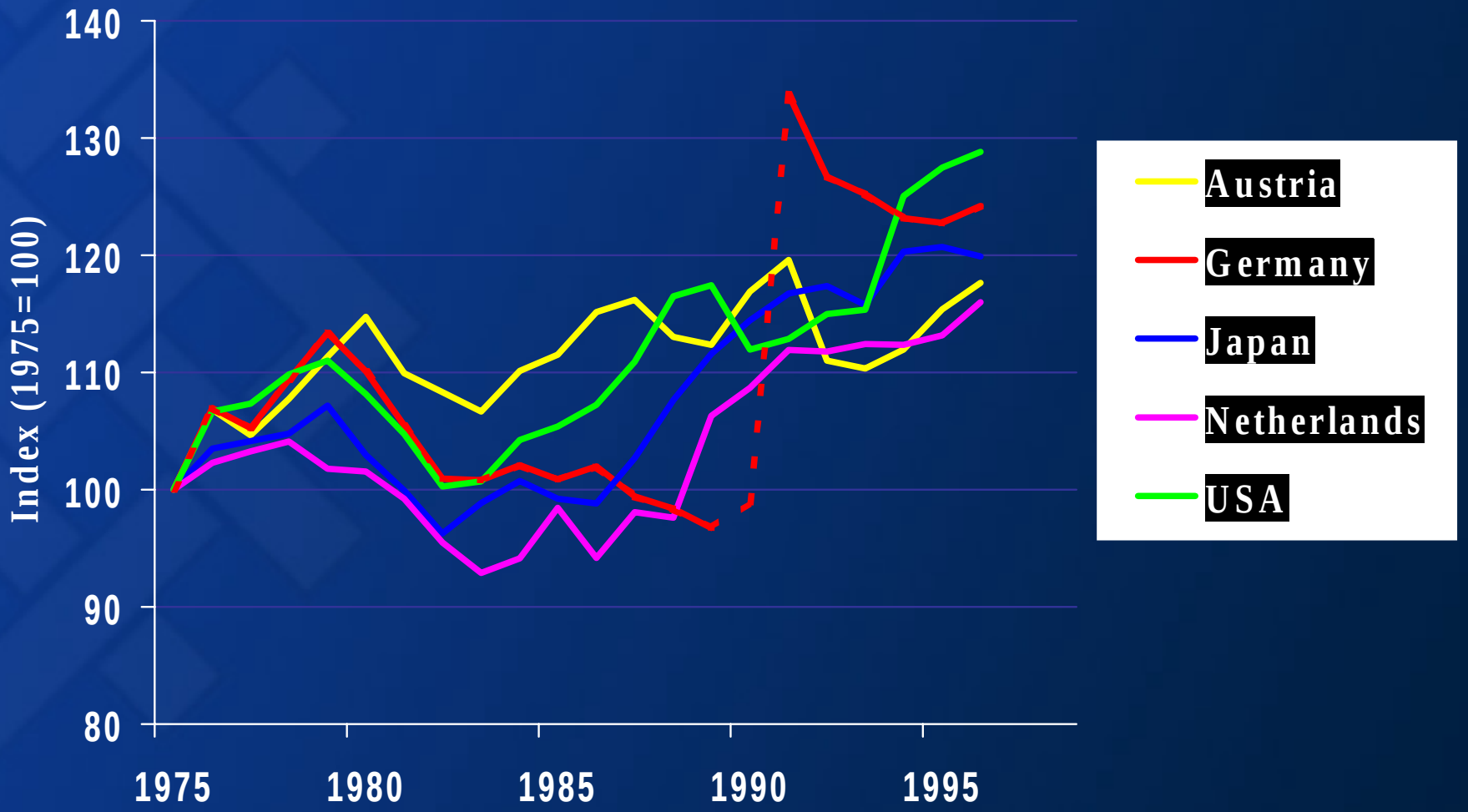
Decoupling between Material Outputs and GDP, 1975-1996



Decoupling between Material Outputs and Population, 1975-1996



Domestic Processed Output, 1975-1996 (Index)



Policy Messages

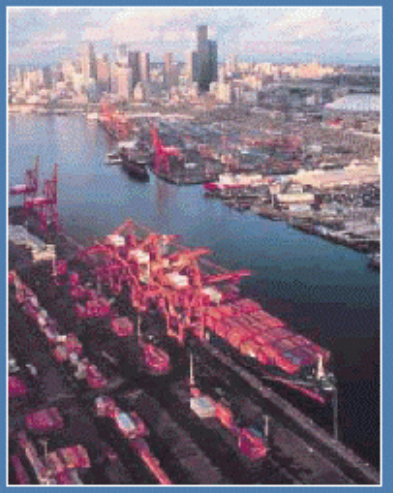
- Many major flows not measured or considered in environmental policy
- Economies continue to grow in physical terms
- Many hazardous flows occur upstream and downstream of processing and manufacture
- Too many flows to regulate individually
- Decoupling is happening - but it's not enough
- Essential to look at the entire material cycle in developing resource and waste policies

Possible Implications for Industry

- More emphasis on self-regulation?
- Performance targets?
- Design for environment?
- Extended producer responsibility?
- Information and disclosure requirements?
  - company reporting
  - product labeling

THE WEIGHT OF NATIONS

MATERIAL OUTFLOWS FROM INDUSTRIAL ECONOMIES



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